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Presence-based, Context-sensitive Real-Time Collaboration (RTC) – research directions for a new type of eCollaboration system

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Presence-based, Context-sensitive Real-Time Collaboration (RTC) – research directions for a new type of eCollaboration system

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Abstract

This paper presents Presence-based, Context-sensitive Real-Time Collaboration (RTC), a new and emerging eCollaboration technology that has its roots in both the telecommunications and groupware market. The aim of the paper is twofold. Firstly, it offers a conceptualisation of RTC consisting of usage scenarios and four main building blocks – integration of communication channels, presence-awareness information, context integration, and further eCollaboration features. Secondly, the paper intends to offer a starting point for future research on RTC as it attempts to touch upon and systematise different research directions and typical questions for researching RTC in the future in order to understand the organisational implications of this complex and embedded information system.

Keywords: Real-time Collaboration, Virtual Collaboration, Presence Awareness

1 Introduction

Presence-based Real-Time Collaboration (RTC) presents itself as a new and emerging technology in the eCollaboration arena with a wide range of new products currently entering the market. Initially created by integration of instant messaging tools, with their text chat functionality and presence awareness information, and communications technology, in particular Voice over IP (VoIP) communication, the field of RTC has been maturing over the past three years. Further information and communication channels have been added and RTC technology shows significant potential for integration with other collaborative applications, general purpose software like office software, and enterprise-specific systems and

processes. However, RTC systems are still in their infancy, with new systems not yet living up to the promises RTC providers present in their roadmap documents. While these roadmaps and show case prototypes illustrate the potentials of RTC technologies, empirical examples of RTC application in organisations that show the envisioned features are yet to be found.

The paper is intended as a starting point for research on RTC by conceptualising RTC, illustrating its potential implications and outlining potential research questions. Therefore, the paper starts with a discussion of recent organisational and technological developments that led to workplace changes which can be seen as a driving factor for the development of RTC systems. Drawing from these challenges of dispersed workplace setups, section 3 introduces the main building blocks of RTC systems. While section 4 gives a quick overview of typical RTC systems and their providers, section 5 discusses five RTC usage scenarios that illustrate RTC applications in contemporary work environments. Finally, section 6 presents a research agenda and distinguishes research perspectives, levels of analysis and makes propositions for research approaches and future studies. RTC technology is promising and complex at the same time and needs deep integration within organisations in order to enfold its potential. At the moment, there are not only many open research questions regarding the design of RTC systems, but also in regards to the social and organisational implications of change induced by RTC application.

2 Background

Today's work practices have been undergoing significant changes over the past couple of years, leading to new forms of organizing, communicating, and collaborating. The virtualisation of organisations and work contexts on the one hand and the emergence of new information and communication technologies and devices on the other hand are two major causes for this development. These two drivers led to an all but perfect communication situation from the point of view of the user as well as those organisations that rely heavily on dispersed collaboration across organisational units.

2.1 Virtualisation leads to dispersed workplaces

New virtual forms of organising present new challenges for people working in these increasingly dispersed setups. These changes in the workplace are fuelled, on the one hand, by a trend towards inter-firm partnering that manifests itself in the formation of strategic alliances, joint ventures, and business networks and, on the other hand, by general tendencies towards organisational flexibilisation, which leads to internationally diversified organisations. These organisational developments are enabled by the capabilities of modern information systems and infrastructures like the Internet. The claim is that organisations can improve their performance levels by capitalising on the potentials of groupware technologies as teams can be formed corresponding to individuals' qualifications rather than their local availability [43,25]. 'Virtual', 'remote', 'dispersed' or 'mobile' forms of collaboration have gained increasing interest and assumptions are being made that some 'new' sets of activities can be contrasted from 'traditional' forms of carrying out work [5]. A large body of research concentrates on understanding the implications of these forms of collaboration on issues such as leadership [41,44], trust [18,21], managerial issues [41,15,30], communication [16,6,8,29], and organisa-

tion [3]. Although recent studies caution against the performance claims of virtual forms of organisation [17,38], the existing academic interest in the topic mirrors the ongoing transition of today's work practices as well as the importance of the topic. As a consequence of these trends, fragmented and dispersed workplaces with teams being spread over several locations are common today. Hence, people rely more and more on media-based communication and groupware-supported collaboration.

2.2 New communication technology increases complexity

Over the last two decades, the number of communication channels and devices has increased, creating a heterogeneous accumulation of technologies that are available to the average user [27]. With new technologies entering the arena, like Voice-over-IP telephony, the increased bandwidths of mobile network infrastructures, as well as the increased popularity of instant messaging systems in organisations, the communication options have mushroomed. To add to the multitude of communication channels, many people do not just possess one e-mail address, phone number, or instant messenger account, but rather they use several similar channels for corresponding with their peers across a number of social groups. Consequently, the communicative complexity increases drastically for both the initiator and the recipient of a communication request. For initiators situations are characterised by a high uncertainty as they have to think about the recipient's location and context, the appropriate channel, and the relevant contact details in terms of accounts and phone numbers. Generally, all required information is not at the disposal of the initiator, resulting in failed communication attempts that are time consuming and costly. The recipient on the other hand is confronted with a myriad of communication devices as well as several addresses and numbers, creating a fragmented communication landscape whose coordination is time consuming and tedious.

2.3 Interaction overload as a consequence of the two trends

These two trends bring about structural changes to today's working environment that manifest itself in the workplace situation of people, i.e. the situation of virtual team members and mobile professionals [cf. 19]. Today's work conditions are marked by increased fluidity of interactions with others. While fluidity offers benefits, such as interacting remotely and flexibly with others, it also creates interruptions and disturbances as asymmetries of interaction become more likely [20]. Asymmetries of interaction occur if "the time and topic are convenient for the initiator, but not necessarily the recipient. This asymmetry arises because while initiators benefit from rapid feedback about their pressing issue, recipients are forced to respond to the initiator's agenda, suffering interruption" [32: 83]. Current technologies such as mobile phones offer only limited support for people in managing their increased communicative volume. Specifically, the effect of decreasing communication delays of new technologies on the part of the initiator of a communication request often translates into a work interruption on the part of the recipient [37]. And interruptions most often come at the cost of deeper concentration on a single task [7]. Information and communication requests reach each person unfiltered and people don't have gatekeepers which might help to manage and control the communicative volume. Consequently, people are poten-

tially confronted with a level of interaction that might exceed their personal preferences causing a problem called interaction overload [40].
In such a situation, people might fall back on tactics for minimizing interruptions or avoiding communication altogether: “For many users, the only way to avoid this media terror is to abstain from these media completely: to have their telephone off the hook or work at home.” [7: 75] While this situation is unsatisfying at the individual level it also translates into organisational frictions in that information processes do not operate as smoothly as they should or that the lack in availability of key personnel causes problems in projects and ultimately leads to higher overall cost for the organisation.

3 Real-time collaboration technology

Real-time collaboration technology (RTC) can be seen as a technological attempt to mitigate the problems portrayed above. Resulting of market convergence, RTC has its roots in both the telecommunications market and the market for groupware systems. Hence, well-known features of RTC systems are Voice-over-IP telephony and instant messaging features. RTC is based on the idea of unified communication (UC), which describes the computer-supported combination and management of communication channels according to user preferences. Besides providing an integration of communication channels and devices, RTC also integrates various groupware and eCollaboration features. All in all, RTC overcomes the traditional distinction between either synchronous or asynchronous technologies as both aspects may be integrated within one application. However, one of the main features of RTC lies in the provision of status information in regards to the availability of the user and his media and communication devices. Finally, RTC systems unfold their strengths when integrated within the context of the user, in particular with organisational processes and software tools. Consequently, four main components of RTC systems can be distinguished (see figure 1).

3.1 Unified communication features

The idea behind Unified Communication (UC) is to relieve the user of the burden to juggle with a large number of devices and channels in different contexts. UC systems thus aim at integrating different information and communication channels, such as e-mail, telephone, instant messaging, or SMS in order to reduce the fragmentation and complexity of today’s information and communication landscape. UC is an extension of the earlier concept of Unified Messaging (UM). The aim of UM systems is to manage and coordinate a user’s asynchronous communication through a single portal in which all incoming messages of various channels such as email, audio messages, fax, or SMS are collected and which allows for a conversion of messages between these media types: fax and short messages can be forwarded via e-mail, text messages (SMS, email, Fax) can be read to the user by a machine voice, and the user can decide which device to use to access messages of various types.

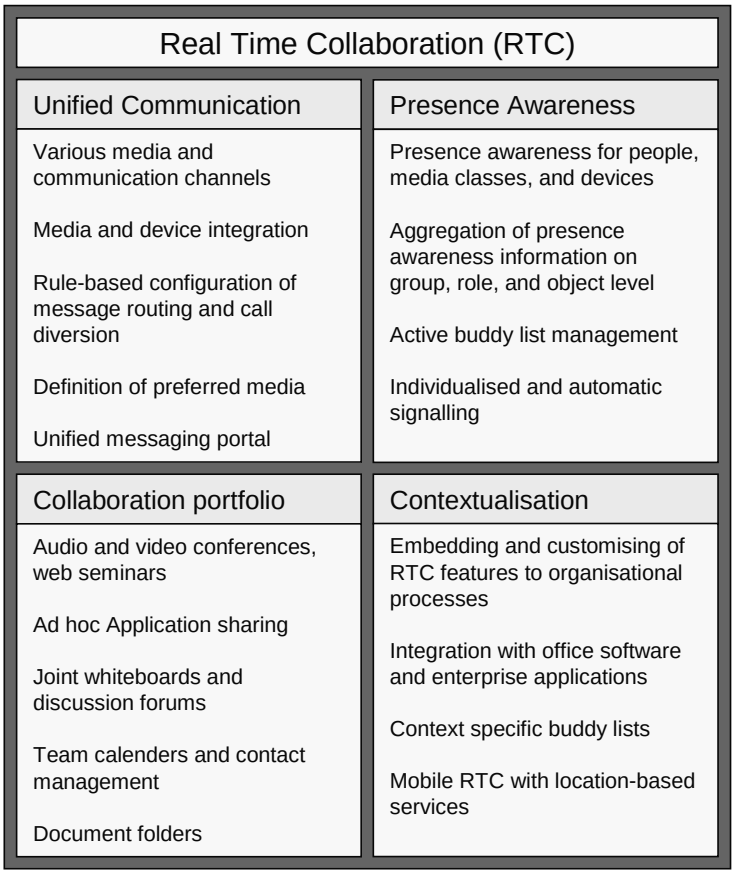

Figure 1: Building blocks of real-time collaboration (RTC) systems

UC extends the UM integration idea to synchronous communication. Users are aided by a communication middleware in the management of channels and devices through a rule-based coordination and filtering system. The user can define preferred channels (text, audio, and video) and devices (landline, mobile or IP phones). Incoming calls can thus be diverted and transferred between channels and devices according to a set of filters or rules. These rules can be related to time, situations ("in the office", "at home"), or callers ("colleagues", "customers"). For example, when the user is not logged-in to his office computer, all incoming calls from colleagues might be transferred to the mobile phone, while after hours any caller might be diverted to the voice box.
Hence, UC features enable users to manage their channel complexity and communication volume corresponding to their preferences and contextual demands. The locus of control thus is shifted from the initiator to the recipient who can decide which media and devices to use or which requests might need immediate consideration.

3.2 Presence awareness information

The second defining feature of RTC is the presence awareness information, a concept well-known from the increasingly popular instant messaging tools, where the availability of people is signalled by a status icon in a contact list. While Giddens argues that presence-availability means that someone *can* talk to others who are in the same location [12], RTC expands the notion of presence-availability across space in that people's awareness is expanded. In RTC systems presence awareness

information signals to the initiator of a communication act, independent of a recipient's physical location, the availability for interaction, e.g. the "ability and willingness to communicate" [7: 84]
According to Dourish and Belotti awareness "is an understanding of the activities of others, which provides a context for your own activities." [9: 107] Hence, presence awareness information allows for a more focused communication in that the availability of the recipient is known before the communication attempt and thus provides a valuable context for the initiator's actions. Thereby, unsuccessful communication attempts are reduced as is the need for asynchronous messaging in cases where the recipient can't be reached. Consequently, RTC can reduce the communication complexity, lead to improved reachability of people, and thus imply significant time savings for both the initiator and the recipient. The following complexities of presence awareness information have to be considered:

- A person's presence awareness information can be derived from the availability of channels and devices in that for each device or for a particular channel (text, audio, video) a presence status is provided. For example, the status for audio communication might be 'available', if one of the user's audio devices is registered being 'active' by the RTC system. To the contrary, both audio and video communication status might show 'temporarily unavailable' whenever the user is talking on one of the registered audio/video devices. In the latter situation, synchronous text communication via instant messenger might still be possible, as this does not have the same disruptive impact on the recipient.
- While in most instant messaging tools the presence-awareness information is always related to the availability of one particular person, professional RTC systems extend the notion of presence awareness to identities such as roles, skills, groups, locations, or objects. 'Identities' can then be attached to documents or be used in enterprise applications to allow people to access, on an 'on-demand' basis, responsible individuals without knowing in advance who they are. In doing so, presence awareness information can be attached to objects (e.g. a file) and indicate if one of the people, who can provide further information in regards to the object, is available for direct communication via the RTC system. Possible scenarios are hospital settings, service recovery settings, journalism, logistics, and field services, where information is critical and the ad hoc availability of relevant people paramount (see scenarios below).
- Another awareness facet is the possibility of active presence management by the user. To avoid interaction overload, recipients can filter incoming information and communication requests as they assign priorities and preferences to particular events. Recipients can actively manage their contact list according to priorities or contexts, thus restricting availability for certain people in certain circumstances. Active signalling is important to avoid interruptions when engaged in a particular creative or annoying/boring task, where interruptions are less tolerated [7].

3.3 Contextualisation

The third area of RTC comprises the above mentioned integration of communication features to organisational processes in order to enable context-sensitive cooperation. In such a scenario, the user can initiate a communication act immediately

from the software application in use without having to decide on a particular channel for reaching a recipient or having to search for contact details and a suitable device. The RTC system can present the user a context-specific buddy list that only contains people important in a particular context (e.g., all specialists for a problem). For example, an insurance specialist might be able to see immediately in the CRM application whether a colleague, who has entered a customer complaint to the system, is available for conversation in regards to the case. If the presence awareness status of the colleague signals availability, the insurance specialist can initiate a phone call directly from the application by simply pressing a button (e.g. via VoIP). Furthermore, the user might be able to access location-based services, which make available the RTC functionality on mobile devices (e.g. PDAs or mobile phones) to support the user while travelling.
Through such an integration of RTC systems with processes and enterprise software, ad hoc communication is made possible and the communication has less interrupting character for the user's flow of work, especially in cases where specific information from colleagues is needed urgently. Here again, unsuccessful communication attempts are reduced, as is the communication complexity.

3.4 Portfolio of eCollaboration features

The final component of RTC systems is a portfolio of eCollaboration resources and features. While ad hoc communication is at the centre of RTC, collaboration features might enrich the ad hoc interaction between users. True real-time collaboration is enabled by integrating features such as web conferencing and application sharing.
With web conferencing functionality users might be able to establish communication with more than one recipient at the same time. Using presence awareness information on the group level, a user is able to see if a particular group of people (or at least a certain number of group members) is available for ad hoc communication. If so, the user might establish an audio or video conference with the whole group in order to have an ad hoc real-time meeting while people might be spread over various locations. By integrating application sharing features, the RTC system might allow users not just to communicate with their peers in regards to a particular document (e.g. an insurance file), but to jointly work on the document on an ad hoc basis. An application might be launched hat provides audio/video communication and joint real-time editing of the document at the same time.
Another facet of integrating RTC with established eCollaboration resources is the integration with team calendars. Presence awareness information of people might be combined with calendar information in order to provide background information as to why and for how long a particular person might be unavailable. Also, the integration of presence awareness information of team members in the calendar might improve the scheduling of meetings [7].
In summary, four areas can be distinguished that characterise RTC systems. Potential benefits of RTC comprise a better management of personal communication complexity, a better availability of people and required information, improved control over incoming requests, less unpredictable disruptions of the work situation by incoming communication requests, as well as the establishment of collaborative real-time interactions on an ad hoc basis. The following section gives a brief overview of the market for RTC products

3.5 Exemplary RTC products

Currently, RTC products address mainly two market segments, the mass market for private customers and the market for business customers (see table 1). Skype is a good example for the first segment providing basic VoIP and instant messaging features. The business segment is served by players from the telecommunications market such as Siemens, Alcatel, and Nortel and by traditional software providers such as Microsoft, Oracle, or IBM [11]. Siemens for example developed Hipath OpenScape on the basis of its telephone and unified communication infrastructure, targeting enterprises that want to set up comprehensive RTC environments while integrating their traditional telephone infrastructure. IBM on the other hand bundles and extends existing groupware solutions (e.g. Lotus Domino products) in its IBM Workplace Collaboration Services (WCS), offering various eCollaboration features that are going to be integrated with RTC features provided by Lotus Sametime. Over the next years, a maturation and refinement of existing RTC products can be expected, as well as an increased integration with software tools such as office and enterprise systems in order to facilitate the above discussed context-sensitive collaboration. Following these developments, eCollaboration systems might no longer exist as autonomous systems, but provide their functions directly in the user's work context.

Market segment	Companies
Private customers	• AOL Messenger • Gizmo Project • Google Talk • MSN Messenger • Skype • Yahoo! Messenger
Business segment	• Alcatel OmniTouch Unified Communication • IBM Workplace Collaboration Services (e.g. Lotus Sametime) • Microsoft Office Communicator 2005 • Nortel Multimedia Communication Server 5100 • Oracle Collaboration Suite • Siemens Hipath OpenScape

Table 1: Overview of some main players in the RTC market.

4 RTC usage scenarios

The following scenarios aim at illustrating the potential application of RTC systems in organisational settings. They have been selected in order to illustrate RTC application on different organisational levels and to draw a rich picture of implications such as bridging spatial distances, enabling time critical communication, and improving reachability of people.

4.1 Professional service firm (consultancy services)

A consultant who travels frequently and works on site with the client can benefit from RTC applications by managing communication requests on different devices through criteria such as priority, presence-awareness-status, time-of-day, day-of-week, or device. If the consultant, for example, decides to work at home, all incoming calls from team members via the office phone number will automatically be forwarded to his/her private phone number and if that fails, to the mobile phone. All other calls will be diverted to a self-service-portal. The self-service-

portal allows, depending on the initiator's access properties, to access the consultant's calendar, to schedule appointments, and to read and retrieve documents stored on an exchange folder. The consultant can check e-mails, voice-mails, and appointments over a voice-portal while not in the office. The example illustrates that RTC does not shift control to the recipients without taking the initiator's needs into account. Rather, initiators are assured that they can close the bracket of a task, as RTC either allows direct communication or enables initiators to leave a message, schedule an appointment, or access requested documents. Therefore, RTC can contribute to minimising delays on the side of the initiator and gives recipients the control over organising their work settings.

4.2 Hospital laboratory (emergency room)

In the hospital context the availability of critical information can have life-determining importance. This might apply to information in the patient's records and to background information regarding laboratory files. Given that an increasing number of hospitals use electronic patients' records today, an integration of these hospital information systems with real-time collaboration functions may prove beneficial. In such a system the presence awareness information of authors of laboratory files or patients records can indicate their availability for urgent call-backs by the doctor on duty. Through such RTC features, the doctor might be able, in case of an emergency, to get in immediate contact with specialists and laboratory assistants in order to have access to background information about the patient' record or to consult with colleagues. A precondition for this scenario to work is the aggregation of availability information at the object level, in this case at the file level. Besides, organisational rules regarding the on-call service and the usage of mobile devices are necessary, in order for people to be available at any time for ad hoc communication via the RTC system.

4.3 Field services (travelling sales man scenario)

In mobile field services, RTC solutions might offer advantages, e.g. when a field representative urgently needs information from people in the organisation or wants to contact a suitable expert. Examples are the insurance broker who has questions regarding a contract, the technician who needs immediate advice in order to solve a technical problem, or the reporter who needs background information for a report from the editorial staff in the back office. Common to all these examples is the urgency of the communication request. The information is required exactly when the employee is on site with the customer or at the place of an event. Thus, the direct accessibility of experts is paramount. A real-time collaboration system with suitable availability information may significantly improve communication in such situations. The initiation of communication request might be based on a role model, because most often it is not necessary to contact a particular person, but somebody with a certain competence or role. Hence, aggregation of presence awareness information at the role level supports the employee in selecting a suitable expert. In this case, a context-sensitive buddy list for a particular role (e.g. a network specialist or insurance broker) can be presented to the field representative. Preconditions for such a scenario are a context-sensitive role-selection algorithm in order to create the buddy list and the integration of the RTC system with the mobile devices of the field representative.

5 Research directions

Drawing from the four building blocks and the three scenarios discussed above, RTC presents itself as a novel type of information system that is about to reach a critical threshold to have an impact in organisations. However, RTC technology is still in a prototype stage; empirical cases have yet to show the full characteristics of envisaged RTC systems. At the moment, only single RTC components such as unified communication features (without presence awareness information) or instant messaging tools are used in organisations. It can be expected that the first RTC systems will be applied in organisations over the next few months. The design of RTC systems, their technical and organisational implementation, the configurations of the resulting socio-technical systems, as well as the resulting social and organisational implications have yet to show up on a broad scale. However, this early stage opens interesting perspectives for researchers in that the full RTC life cycle might be subject to research, which presents the opportunity of carrying out, among others, longitudinal research studies. In the following paragraphs possible research questions on different levels of analysis will be discussed. In doing so, two main research perspectives are distinguished.

5.1 Design science vs. behavioural science research

According to Hevner et al. two paradigms can be distinguished in information systems research, each approaching it from opposing albeit complementary angles. The two are called design science and behavioural science research. While the behavioural science paradigm aims at developing and testing theories regarding the usage and application of the IT artefact in organisational contexts, design science researchers develop and evaluate IT artefacts that are intended to solve organisational problems [14].

Applied to the RTC arena, design science research focuses on the design and configuration of RTC solutions, their technological implementation, and usability aspects, while the behavioural science perspective deals with the social and organisational implications of such systems. Currently, RTC is at its outset and both the design science and behavioural science paradigm with their diverging stances are needed as to imagine and advocate the design and usage of RTC and then refine and deconstruct the existing understanding based on empirical data in regards to RTC implementations in organisations.

5.2 Design and evaluation of RTC systems

Design science research essentially takes a software engineering perspective and focuses on the RTC artefact, which is the information system with its interface, features, and specific technical implementations. Thus, it aims at creating and evaluating systems or prototypes thereof. In doing so, RTC prototypes or isolated RTC features might be tested in user experiments in regards to usability, patterns of usage, as well as user perception in terms of relevance of particular features. Furthermore, design science research might feed into more empirical research such as action research e.g. in order to evaluate the implementation of different RTC features in a more natural user setting. Questions that might be of interest are concerned with what might be part of a typical portfolio of RTC features, questions regarding appropriate means of supporting users in the signalling process, or

to what extent presence awareness information might be attached to objects such as documents, persons, and devices.

5.3 Implications of RTC usage on different levels

At this point in time, behavioural science research will mainly be theory building in nature and focus on the implications and impact of RTC systems on different levels. While no direct empirical results regarding the implications of RTC exist at the moment, it can be argued that the study of RTC can be informed by work carried out on earlier groupware, such as Lotus Notes, as some of the implications of RTC are likely to be similar to those of such groupware systems. Generally, groupware is best described as general-purpose-technology that needs to be adapted to the organisational context to match with users' work practices, communication norms and local conditions [2]. Its properties are dependent upon the context and are enacted by individual or collective, intended or unintended activities [34]. The implementation process is never completed but should rather be understood as a continuous process with anticipated, emergent and opportunity based changes [33,35]. Taking such an understanding of groupware as a starting point, IT-researchers investigated so far, among other things, the use of groupware for knowledge management [28,36], the role of mediators during the implementation process [2], groupware innovation [22], socio-political issues [13,23] and the importance of the organisational context [4]. While it can be argued that practitioners and academics should learn form the experiences gained from these studies, as this is the closest understanding of the organisational implications of RTC one can get at the moment, it will be required to undertake new empirical endeavours specific to the application of RTC in order to fully appreciate its specific implications. For this purpose, research questions on different levels of analysis and in regards to different RTC aspects can be identified (see overview in table 2).

Three levels of analysis can be distinguished for researching RTC implications within organisations. Firstly, the organisational level deals with organisation-wide implications such as the effects of RTC on the way communication is carried out and the potential impact on organisational culture and climate. Here, RTC might lead in two opposing directions. The increased presence awareness and availability of people might lead to a more communicative culture and increased information sharing between organisational units, which can have significant positive effects on knowledge creation [31,42]. On the contrary, people might feel threatened by the increased awareness and oppose RTC adoption, e.g. in that they deliberately signal non-availability or refuse to use the system entirely. Empirical research might try to answer questions regarding the antecedence and determinants for either of the two situations.

Secondly, on the group level questions regarding the RTC impact on group structures and social behaviour are of interest. For example, the proliferation of presence-awareness information potentially affects people's perceptions of inclusion or exclusion [39]. While inclusion refers to a person's perception of being part of social groups, exclusion represents an individual's feeling of being left out and being at the periphery of the organisation.

Level of analysis	Areas of interest		
	RTC potentials	**RTC challenges**	**Change implications**
Organisation	What will the main benefits of RTC be – cost savings, better coordination, flexibility of organising work, etc.? What type of organisation/process might benefit the most from RTC - structured or already flexible ones? Will RTC lead to lower cost of communication or will the savings be compensated by increased time spent using RTC? Will RTC systems strengthen social networking in the organisation? Will RTC systems lead to a culture of open communication and information sharing?	Will RTC systems have to be heavily customised to show the desired effects in organisations? What will be the retarding factors for RTC adoption – technological complexity, required change, investments, culture, etc.? Will RTC systems lead to a culture of control and surveillance?	Will RTC systems have to be integrated with typical enterprise information systems? What organisational changes are necessary to communication structures, rules, and processes? Who has to be involved in managing the RTC change process? What are the effects of RTC on organisational culture and climate? What are typical areas of RTC application – internal processes, mobile workers, creative work, structured processes, etc.?
Groups/ teams	Will RTC help mitigate social barriers in dispersed setups, e.g. lead to a higher perception of social inclusion? Will RTC lead to better coordination in knowledge intensive work processes? Will RTC help to mitigate issues caused by diversity in cross-organisational teams?	Will people accept the additional awareness of their activities for others or will people feel controlled? Will RTC thus evoke resistance in the social group? What is the effect of group culture on successful RTC adoption? What effect do network brokers (or technology champions) have on RTC adoption?	What changes to group processes will RTC induce? Will RTC lead to higher centralisation or decentralisation of social networks?
Individual	Will RTC help to attain time critical information more easily? Will RTC usage reduce unwanted interruptions? Will users experience more control over their interactions with RTC? Will RTC enable a better personal time management?	Will RTC lead to increased interruptions of people whose expertise is in high demand? Will RTC (e.g. the chat feature) distract people from their actual work? Will the user perceive the possibility of active signalling as useful or cumbersome? What are suitable measures to automate the signalling process? Are these measures context-dependent or universal?	Will people show different interaction behaviour due to the new means of social signalling? Will people use the signalling mechanism to hide and block out others?

Table 2: Some research questions regarding the implications of RTC systems.

Finally, individual-level research might investigate how users take on board RTC ideas and integrate it in their every day communication behaviour. For example, while one promise of RTC systems is to reduce bothersome interruptions of recipients, in specific situations RTC can have the opposing effect. People who have a rare expertise that is in high demand within the organisation might find themselves in a situation where they are contacted on a more frequent basis, once the RTC system increases awareness for both the recipient's expertise and the availability for ad-hoc communication.

While these examples illustrate some typical research issues on the three levels of analysis, table 2 presents a more comprehensive overview of possible research questions. To accomplish the levels of analysis, three areas of interest have been distinguished. At the moment, empirical research should investigate whether the promises and intended benefits of RTC hold true in organisational environments and what the potential drawbacks and challenges for RTC adoption might be. Finally, the application of complex information systems such as RTC significantly affects people and quite naturally leads to changes on all three organisational levels. Thus, one aim of research endeavours should be to better understand the variety and degree of change, as well as the managerial implications of RTC systems application.

6. Conclusion

Inter-personal communication and collaboration are essential processes in organisational knowledge work. These collective processes however need to be balanced with the interests of both the recipient and the initiator of an interactive act [7]. Therefore, context information is needed in regards to activities and location of the recipient, which requires signalling of presence awareness information to the initiator. This paper makes a contribution to elucidating the potential of RTC in tackling some of the issues of today's complex working environments. RTC might help people to organise their work by integrating information and communication channels, balancing delays and interruptions of work, and by supporting people to cope with the informative and communicative volume.

Over the next few years, it is expected for RTC to become closely integrated with existing legacy and ERP systems. Currently, no empirical studies exist on the implications RTC has in organisations and researchers therefore are "'dreaming' and 'creating problems' as much as they are solving problems and recording and theorizing about effects" [26: 65]. This paper dared to risk an outlook on the consequences of RTC and argued that people may contact others with the needed skills, resources or job roles, depending on their presence availability rather than previously established contacts. Communication therefore may become more instantaneous or spontaneous as others are only one mouse-click away.

However, it remains to be seen whether RTC systems may live up to the high expectations of their providers. The authors are cautious of any technological deterministic claims. Benefits that are often mentioned in line with mobile technology and RTC, such as minimisation of idle time, faster response time, or more freedom and higher quality of life [1], are not an automatic outcome of technologies. People should be aware that the implications and properties of RTC will depend on the enactment by its users. The most collaborative software is futile if people are not willing to interact or share their ideas [10]. However, generalised representations as given by this article are needed at this early stage as they provide the

canvas upon which to perform deconstructive work [24]. Currently, research in the groupware domain offers a pool of findings one can use as starting point and sensitising devices. Nonetheless, more in-depth analyses are needed in the future to make sense of what the implications of RTC are on organizing dispersed work. While the technology is promising, as the conceptualisation and the scenarios in this paper have shown, the technical and organisational challenges are manifold and yet to be fully understood. For doing so, the paper has presented research perspectives, open research questions and ideas for empirical research. RTC offers scholars a rich field for future research as aspects analysed for earlier groupware need to be revisited and new questions need answering. Prototyping and experimental research might be used to test and evaluate new RTC features, while research in organisational contexts such as action research, ethnographical studies, or case study approaches can be used to provide a richer picture from which conclusions in regards to a variety of research questions might be drawn once empirical examples of RTC applications become available.

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